

CLAIMS

1. A method for preparing a gaseous atmosphere having controlled hydrogen and carbon monoxide contents, in which:

(a) a partial catalytic oxidation (22) of at least one hydrocarbon is carried out at a temperature below 1200°C, a pressure of 3 to 20 bar and in the presence of oxygen or of a gas comprising oxygen, to produce hydrogen (H₂) and carbon monoxide (CO);

(b) a gas mixture is recovered from step (a), comprising at least hydrogen (H₂) and carbon monoxide (CO);

(c) the gas mixture obtained in step (b) is subjected to cooling by direct contact with pressurized water (24), to a temperature of between -20°C and +80°C;

and in which, in step (b) and/or in step (c), a gas mixture is obtained at a pressure of 3 to 20 bar; characterized in that said catalytic oxidation reaction and the cooling step (c) are carried out in one and the same vessel (31), the gas mixture obtained after step (b) immediately entering the cooling zone so as to have a gas transport time between the two zones of catalytic reaction and cooling that is shorter than a few tens of milliseconds, and preferably shorter than 50 ms.

2. The method as claimed in claim 1, characterized in that the gas mixture obtained from step (c) is subjected to a separation step (d) to produce a hydrogen-rich gas stream.

3. The method as claimed in either of claims 1 and 2, characterized in that in step (c), the cooling is carried out by passage of the mixture to be cooled in a shower of pressurized water.

4. The method as claimed in one of the preceding claims, characterized in that the hydrocarbon is

selected from the group of light hydrocarbons such as natural gas, methane, ethane or a mixture of methane and ethane, or a mixture of butane and propane.

5 5. The method as claimed in one of the preceding claims, characterized in that the hydrocarbon is methane or natural gas, the CH_4/O_2 volumetric flow rate ratio being preferably between 1.2 and 2.1.

10 6. The method as claimed in one of the preceding claims, characterized in that the gas mixture obtained in step (b) and/or in step (c) is at a pressure of 4 to 20 bar.

15 7. The method as claimed in one of the preceding claims, characterized in that step (a) is carried out at a pressure of 6 to 12 bar.

20 8. The method as claimed in one of the preceding claims, characterized in that the gas comprising oxygen is a gas mixture comprising nitrogen and oxygen, preferably air.

25 9. The method as claimed in one of the preceding claims, characterized in that the catalyst is formed of at least one metal deposited on an inert support, the metal preferably being nickel, rhodium, platinum and/or palladium, or an alloy containing at least one of these metals.

30 10. The method as claimed in one of the preceding claims, characterized in that the gas mixture obtained in step (b) contains approximately 30 to 40% (by volume) of hydrogen, 15 to 20% of CO, and the rest is
35 nitrogen and possibly traces of CO_2 , H_2O or other unavoidable impurities such as C_nH_m waste, and preferably the gas mixture obtained in step (b) contains approximately 31 to 34% (by volume) of hydrogen, 17 to 19% of CO and the rest is nitrogen and

possibly traces of CO₂, H₂O or other unavoidable impurities such as CnHm waste.

11. The method as claimed in one of the preceding
5 claims, characterized in that step (a) is carried out at a temperature of between 600°C and 1090°C, and preferably between 850 and 1000°C.

12. The method as claimed in one of the preceding
10 claims, characterized in that in step (d), the separation serves to produce a hydrogen-rich gas stream containing at least 80% of hydrogen, preferably 99.9% to 99.99999% by volume of hydrogen.

13. The method as claimed in one of the preceding
15 claims in their dependence on claim 2, characterized in that the separation carried out in step (d) is carried out by means of a PSA method, of a TSA method or of a membrane permeation separation using one or more
20 membrane modules, generating, on the one hand, said hydrogen-rich gas stream and, on the other, a waste-gas stream.

14. The method as claimed in claim 13,
25 characterized in that the waste-gas stream is sent to a cogeneration unit, to generate electricity, preferably to a boiler.

15. The method as claimed in one of the preceding
30 claims, characterized in that it comprises the supplementary step of:

----- (e) ---subjecting the gas mixture obtained in step
(b) to a separation in order to remove at least a
portion of the carbon dioxide and/or steam impurities
35 that may be present, and thereby to produce a gaseous atmosphere having controlled contents of hydrogen, carbon monoxide and nitrogen.

16. The method as claimed in either of claims 13 and 14, characterized in that the separation carried out in step (d) is carried out by means of a PSA method or a TSA method employing at least two adsorbers
5 operating alternately, at least one of the adsorbers being in a regeneration phase while at least another of the adsorbers is in a phase of production of said hydrogen-rich gas stream.

10 17. The method as claimed in either of claims 13 and 14, characterized in that the separation carried out in step (d) is carried out by membrane permeation using one or more membrane modules generating, on the one hand, said hydrogen-rich gas stream and, on the
15 other, a waste-gas stream mainly containing nitrogen and carbon monoxide, and possibly residual hydrogen.

18. The method as claimed in one of the preceding claims, characterized in that the gas mixture obtained
20 from step (c) is free of soot.

19. The method as claimed in one of the preceding claims, characterized in that means (35) are available for accelerating the gas mixture obtained at the
25 reactor outlet between said two zones of reaction and cooling.

20. An installation for preparing a gaseous atmosphere having controlled hydrogen and carbon
30 monoxide contents, comprising:

- a partial catalytic oxidation reactor (22)
-----suitable for oxidizing at least one hydrocarbon, at a
temperature below 1200°C, a pressure of 3 to 20 bar and
in the presence of oxygen or of a gas comprising
35 oxygen, to produce hydrogen (H₂) and carbon monoxide (CO);

- means (24) for cooling the gas mixture obtained at the outlet of said reactor, by direct contact with

pressurized water, to a temperature of between -20°C and +80°C;

characterized in that said reactor and said cooling means are located in one and the same vessel (31) and in that it comprises means (35), located between the two zones of catalytic reaction and cooling, suitable for permitting the acceleration of the gas mixture obtained at the reactor outlet between said two zones of reaction and of cooling, so as to have a gas transport time between the two zones of catalytic reaction and cooling that is shorter than a few tens of milliseconds, and preferably shorter than 50 ms.

21. The installation as claimed in claim 20, characterized in that said cooling means comprise a shower of pressurized water into which the mixture to be cooled is sent.

22. The installation as claimed in either of claims 20 and 21, characterized in that it comprises a deflector system, located downstream of the cooling means, suitable for separating the drops of water in order to prevent them from being entrained by the cooled gas.

23. The installation as claimed in one of claims 20 to 22, characterized in that it comprises a device (26, 27) for supplying and recirculating pressurized cooling water.

~~24. The installation as claimed in claim 23,~~
characterized in that said supply and recirculation device (26, 27) comprises a cooling water filtration system, able to trap the solid particles issuing from the method.

25. The installation as claimed in one of claims 20 to 24, characterized in that said acceleration means (35) consist of an inverted cone system.

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